Riparian Zone Management and Trout Streams: 21st Century and Beyond

Michigan Department of Natural Resources
Fisheries Division

"The Ultimate Battle"

The ultimate battle for the health of a stream, especially a trout stream, is won on the land. If the land within a watershed is not treated properly, the stream will be impacted, perhaps even to the point where it is no longer suitable for trout to survive. Although all land within a watershed is important, the land directly adjacent to a river or stream is particularly critical to its health.

In this article, we will explain the importance and values of river corridors, and identify and discuss tradeoffs and ramifications of different management options. We will also consider aspects of old-growth forest and species diversity within river corridors, and the important management role played by the State Natural Rivers Program. Lastly, we will describe the decision-making process used to balance between science and the many values associated with river corridors. The management and protection of river corridors is very complex, as each watershed and each forest stand is unique. There is no simple "one-size-fits-all" formula.

A riparian area is the area of transition between aquatic and terrestrial ecosystems in which the terrestrial ecosystem influences the aquatic ecosystem and vice-versa. Because of the unique conditions adjacent to lakes, streams and open water wetlands, riparian areas harbor a high diversity of plants and wildlife. Life is simply richer along rivers and streams. Riparian areas are ecologically and socially significant in their effects on water quality and quantity, as well as aesthetics, habitat, bank stability, timber production, and their contribution to overall biodiversity.

A riparian management zone (RMZ) is an area designated and consciously managed to protect functions and values of riparian areas. It may be a subset of, may equal, or may extend beyond the riparian area. For example, the riparian area of a particular stream may extend, ecologically, to the top of an adjacent bluff 100 feet from the stream channel, but its riparian management zone may extend 300 feet or more from the channel to address concerns related to aesthetics and water quality.

RMZs – The Key to Protecting Watersheds from Erosion

RMZs are critical to watersheds, wildlife, fish, trees, and people for many different reasons. RMZs are the last line of defense against pollutants flowing toward a waterway. Adequate vegetation in an RMZ helps filter and trap pollutants such as sediment, excess nutrients, and other contaminants before they reach surface waters. Excess erosion of sand sediment into streams is broadly regarded as the most serious pollutant of streams in Northern Michigan. Michigan researchers have demonstrated that relatively small increases in sand erosion into streams can greatly reduce trout abundance. Similar reductions in the food supply of fish were also documented. Unfortunately, streams flowing through areas with relatively flat topography transport sand sediment very slowly so the negative effects of sedimentation may persist for decades or centuries. Thus, it is critical to prevent excess erosion to the greatest extent possible because of the long time required to restore the health of streams damaged by sediment.

An example of poor RMZ management on an Upper Peninsula trout stream. Trees have been cut right up to the riverbank, which eliminates future deposition of woody debris into the stream. There is additional soil erosion occurring because of this activity, which will degrade aquatic habitat. Photo courtesy of Bill Ziegler, MDNR Fisheries Division.

Losses of fish due to unnatural rates of erosion cannot simply be mitigated by stocking additional fish because excess sedimentation reduces the fish carrying capacity of streams. Fish food supplies, primarily insects and other invertebrates such as aquatic worms, and the physical habitat needed to support productive fish populations are reduced by excess sedimentation. For example, in trout streams, clean gravel needed for spawning is damaged and pools that provide refuge from predators and fast currents are filled with eroded sediment. Fish must expend more energy to swim harder against the current because sources of cover, such as logs, are buried and the stream bottom is smoothed by deposited sediments.

The destructive effects of excessive erosion are not restricted to aquatic organisms. The food of many amphibians, reptiles, birds, and mammals is partially or entirely comprised of aquatic invertebrates or fish. Curbing erosion in RMZs is a high priority for the resource professionals charged with their protection because negative effects from erosion ripple upward from the humble caddis fly to the majestic bald eagle.

Excess sedimentation from exposed soils in RMZs can originate from upland erosion, but a lack of plant root structure along stream banks also makes it easier for streams to cut into, and erode banks. Evidence of stream bank erosion and stream widening is often very evident on streams where landowners have removed trees and replaced them with grasses or manicured lawns. The key to effective natural bank stabilization is to maintain a high density of deeply rooted vegetation types along the stream bank to protect soils from the erosive forces of water.

Large Woody Debris – The Key to Michigan Stream Health

Mature trees along our rivers and streams are critical to stream health because they introduce large woody debris (LWD), which controls how our streams look and how they work. Michigan's glacial geology, which provides for some of the best groundwater streams in the nation, does not provide for the large amounts of rock that you may see in freestone streams in the Eastern or Western United States. In freestone streams, rock and rock outcrops in addition to LWD control how streams look and work. In Michigan streams without the large amounts of rock, LWD is what molds our stream channels and determines how they work.

An example of a properly managed RMZ along a popular northern Michigan trout stream. Note the abundance of woody debris in the river. Photo courtesy of Mark Tonello, MDNR Fisheries Division.

Many of our streams lack adequate woody cover, most of which was removed during 19th century logging to facilitate floating logs to market. LWD provides cover

for salmonids, habitat and food for aquatic invertebrates, adds nutrients, traps smaller debris, provides feeding and resting sites for a wide variety of wildlife, and has other beneficial effects. When leaves, twigs, sticks, and even entire trees fall into streams, they provide both food and shelter for aquatic insects, and habitat for reptiles, amphibians, fish, mammals, and birds. LWD in the river channel slows high water velocities, creates plunge pools, and scour holes and hiding places. Any angler that spends time fishing on Michigan rivers for trout, smallmouth bass, or northern pike knows how important it is to have wood in our rivers.

An example of a trout stream with abundant woody debris in the channel. Photo courtesy of Tim Webb, MDNR Forest, Mineral, and Fire Management Division.

The MDNR and its partners spend many thousands of dollars each year to introduce additional LWD into our river systems; debris that has been lost artificially over time due to a variety of circumstances. Natural recruitment of LWD into a river channel can only occur in areas with mature streamside forests, which take decades to grow. Studies show there must be at least 100 feet of forest on both sides of a stream to ensure successful recruitment of LWD into a stream.

Aesthetics – A Key Human Element of RMZs

Trees protected in the RMZs of northern Michigan provide more visually pleasing settings along streams. The definition of aesthetics centers on the sense of the beautiful. We all have heard of the truism that "beauty is in the eye of the beholder." It is safe to say that most people prefer to view nature in a state not disturbed by human activity. Riparian areas, as a general category, probably are second only to roadsides as the most viewed forest areas. Unlike forested "roadscapes", riparian viewscapes are observed when people are recreating and moving at a much slower pace. Hence, they are more critical from an aesthetical point of view. This is yet another factor that must be considered when managing RMZs.

Unique Wildlife and Habitats – A Key Product of Healthy RMZs

As a rule, greater moisture availability is associated with greater diversity and abundance of life. More species of wildlife use the delicate edge between land and water than any other habitat in Michigan. Ninety percent of all wildlife species use riparian areas for some aspect of their existence during their life cycle. Since the riparian area is a transition between upland and water, it supports plants and animals from both areas. Riparian obligate species are those that *require* riparian habitats for all or part of their livelihood and these include snapping turtles, wood ducks, river otters, etc. Numerous amphibians and reptiles, such as tree frogs, wood turtles, and salamanders, spend much of their life in terrestrial habitats, but need adjacent aquatic cover for breeding and egg-laying in the spring. Notable among birds are eagles, ospreys, and great blue herons, which use aquatic habitats for feeding but nest in large trees near rivers and lakes. While many riparian-associated species are adapted to mature forest conditions, others are adapted to shrub habitats or young, early successional forests. Examples of the latter include yellow warblers and golden-winged warblers.

The protection and maintenance of ecological functions within a RMZ or any riparian area also play a key role in the maintenance of threatened and endangered (T&E) species and their habitat niches. Generally, the occurrence of T&E species is highest in the unique habitats provided by riparian areas. Increasingly, biologists are recommending that forestry activities be modified where populations of T&E species occur in riparian areas. Some examples of T&E species often found in riparian zones include the wood turtle, eastern box turtle, marbled salamander, osprey, bald eagle, red-shouldered hawk, Indiana bat, and yellow-throated warbler. Riparian zones are also critical as travel corridors for other T&E species such as grey wolves who seek the cover provided by riparian zones.

Managing RMZs Statewide – Biodiversity and Old Growth Planning

The MDNR is currently in the process of comprehensive planning that will sustain Michigan's forest biodiversity and some old growth forest areas. Many of these proposed areas are within or adjacent to RMZs, due to many of the reasons listed above. The goal is to set aside some areas where natural processes are left to develop along with the attendant ecological communities. Old growth areas are compatible with erosion protection, large woody debris recruitment, and aesthetic considerations. When old growth designations occur within RMZs, they will generally take precedence over other considerations in the management planning process for the zone.

Managing RMZs on State Forest Land – The Compartment Review Process

Here in Michigan we are blessed with nearly 4 million acres of State Forest land, located primarily in the northern Lower Peninsula and the Upper Peninsula. Our State Forests are used by many different people with a variety of interests, including hunting, fishing, hiking, bird and other wildlife viewing, camping, canoeing, mountain biking, horseback riding, and ORV and snowmobile riding. A myriad of special interest groups like the Ruffed Grouse Society, Trout Unlimited, citizen watershed groups, the Sierra Club, etc. also take interest in the management of our State Forests. MDNR Foresters have the challenging task of balancing all of these interests while trying to grow marketable timber to meet society's need for wood products. Thankfully, there is a mechanism in place to help our foresters manage State Forests and the RMZs that are in them. That mechanism is the open house and compartment review process.

Each year MDNR personnel inventory and evaluate one-tenth of an individual State Forest. Each forest management unit is divided into smaller units called compartments to facilitate better resource management. The information gathered spans a wide range of biological, economic, and social factors. It includes the health, quality, and quantity of vegetative types, wildlife and fisheries habitat conditions and needs, recreational use, archaeological sites, threatened and endangered species occurrences and habitats, road and trail access, oil and gas activities, wildfire potentials, inappropriate use of state lands, erosion problem areas, and land use in and around the compartments. From this information, treatments and management activities are proposed. The overall goal is to continue to provide the variety of values, uses, and products from state lands to benefit the citizens of Michigan while ensuring sustainability of the resources and ecosystems that provide these values, uses, and products for future generations.

The open house is an opportunity for interested people to review the proposed treatments and other management activities and provide input towards final decisions. It also provides people with the unique opportunity to talk with foresters and biologists about issues of interest. The compartment review is usually held several weeks after the open house. At the compartment review, the various resource disciplines in the Department (such as fisheries biologists, wildlife biologists, and

recreational specialists) gather together with the local MDNR forestry staff to finalize decisions.

One important tool used during this process is a Michigan Department of Natural Resources (MDNR) publication entitled "Water Quality Management Practices on State Forest Land". This publication lists Best Management Practices (BMPs) for preserving water quality while managing the State Forests of Michigan. It describes such practices as RMZ buffer strips, road planning, site preparation, and other methods to best protect our lands.

Natural Rivers – A Key Tool to Ensure Wise Land Use in Riparian Corridors

By the late 1960s, Michigan residents recognized the importance of maintaining Michigan's outstanding river resources and their need for long-term protection. As a result, the Michigan Legislature passed the Natural Rivers Act in 1970, which is now known as Part 305 of PA 451. To date, Michigan has designated 14 rivers for protection under the Natural Rivers Act, totaling 1,698 miles of mainstream and associated tributaries, which is less than 5% of the roughly 36,500 total stream miles in Michigan. The last river to be designated was the Fox River in the Upper Peninsula, in 1988. MDNR is, however, currently working toward designating 234 miles of the upper Manistee River watershed and 159 miles of the Pine River watershed.

Along Natural Rivers, riparian vegetation is mostly protected from cutting to provide fisheries and wildlife habitat, filter runoff, provide shade to cool water temperatures, prevent streambank erosion and sedimentation of the stream, and maintain the scenic qualities of the stream. Vegetation on public lands is protected for a distance ranging from 50 feet to 200 feet on each side of a river or tributary, as measured landward from the ordinary high water mark. Typically, limited timber harvest can occur within the vegetation buffer but clearcutting is not permitted.

Protection under the Natural Rivers Program is unique because it provides for appropriate and reasonable management of habitat and development on both public and private property along a designated river. This creates a seamless corridor of protection, unaffected by ownership pattern or local government boundaries. Again, the battle for the health of a stream is won on the land, and therefore the Natural Rivers Program is an ideal tool for improving and maintaining the health of our streams.

An example of a stream with a well-managed RMZ. Note the large amount of woody debris in the stream channel. This is one of the top trout streams in Michigan, and you can see why. Photo courtesy of Dan Pearson, MDNR Fisheries Division.

Trees vs. Grasses – Managing Riparian Zones

There is often discussion as to whether wooded riparian corridors are superior to those dominated by grasses and forbs. The key is to manage the riparian corridor vegetation for mature natural species that have evolved to grow in conditions specific to that area. These species should be managed to be healthy and vibrant. It is important to remember that the riparian ecosystem along a stream is controlled by valley shape, water table, soil conditions, groundwater flow, and other characteristics of the stream itself. Vegetation plays a very important role, however, in continuing to maintain the stability of the stream channel so that it does not erode excessively. Thus in

historically forested watersheds throughout Michigan, mature forests are most suitable for protecting our streams, in particular our trout streams. This may not be the case in other states that have "prairie" or other types of landcovers that are not dominated by trees. Even in Michigan though, there has always been some variation in riparian ecosystems. Along rivers there have always been multiple forest types (such as meadows, wet meadows, cedar swamps, and tag alder swamps), depending on physical characteristics of the watershed. Natural disturbances such as forest fires and blowdowns have also created openings that altered the riparian zone.

Another example of one of Michigan's top trout streams resulting from good management of the RMZ. Note the large amount of woody debris in the stream channel, with a mix of grasses and vegetation along the shoreline. Photo courtesy of Dan Pearson, MDNR Fisheries Division.

While grass species have dense roots that can help stabilize eroding stream banks, trees and their associated deep root systems are by far the best method for preventing and reducing bank erosion along streams in historically forested watersheds found throughout Michigan. Grass and forbs simply do not have the root mass that is characteristic of mature trees. That's why fisheries biologists advocate protecting trees and shrubs in RMZs as the best method for preventing and/or reducing soil erosion. Invasive and expensive methods would be required to establish and maintain dense plots of grasses where the natural climax plant community is comprised primarily of trees and shrubs. Further, trees have the added advantage of providing shade, which is particularly important for maintaining cool temperatures in streams where groundwater inflow is too low to keep the stream cool during hot summer periods. Solar radiation can also overwhelm groundwater-driven streams, making them too warm for trout.

If all trees are removed from the riparian zone and vegetation is converted to a grass/forb community, you will see additional bank erosion and channel changes in many streams. The stream channel will make adjustments to deal with the increased sediment supply, which will include increased sediment deposition, bank erosion, and changes in the gradient of the channel. A consequence of these adjustments will be changes in the meander of the stream as the stream seeks to stabilize itself. Ultimately this results in degradation of aquatic habitat. In other streams, the removal of woody vegetation to create a grass/forb community may not significantly impact the shape and structure of the stream. It will reduce, however, the availability and natural recruitment of large woody debris needed for fisheries habitat. Shade will also be lost, allowing stream temperatures to rise and making the stream less suitable for trout even in groundwater-based streams.

A Case Study in RMZ Management – The MDNR Beaver Management Policy

In April 2001, the MDNR Management Team adopted a Beaver Management Policy. The policy is based on two principles. The first is that beaver, trout, and the habitats they live in are managed for human needs and wants. The second principle, derived from the first, is to provide for the less common natural resource (high quality coldwater streams) while still providing opportunities for the more common to exist. While the presence of beaver can be beneficial, high beaver populations can cause a variety of problems for other natural resources and society in general. These include, but are not

limited to, a number of negative impacts to trout habitat, loss of trees, and damage by flooding to roads, railroads, private property, and buildings. While beavers are an integral part of many forest ecosystems, their numbers can reach a point where they significantly change the functions of riparian ecosystems. For example, large clearcuts along Michigan streams often result in aspen regrowth, which is the prime habitat for beaver. The result can be a local overpopulation of beaver, resulting in a number of biological problems for the trout stream in question, as well as social problems. During the compartment review process managers strive to maintain beaver populations at a sustainable level without endangering or threatening other unique natural ecosystems.

Compartment reviews lead to management decisions about what cutting practices to allow in RMZs. This requires MDNR field staff to make choices that will affect habitat diversity and, therefore, species diversity. These decisions require tradeoffs and compromise to achieve the "best" balance between values associated with wildlife, fisheries, forestry, aesthetics, and economics. These decisions are not simple. For example, if your primary interests are woodcock, grouse, and deer hunting, then you may subscribe to the view that habitat diversity should be defined as a diverse mix of young and old timber stands in riparian zones. You might advocate clearcuts of aspen in riparian zones to provide early successional habitat favored by your favorite game species. By contrast, other stakeholders favor older-growth tree communities inhabited by more non-game species. If you are a grouse and woodcock hunter, bird watcher, and a trout angler, your decision becomes even more complex. Aspen, whose regeneration is promoted by cutting, is also a preferred food and dam building material for beaver. Beaver dam impoundments increase the diversity of an array of game and non-game species, including non-game fish species. However, the tradeoff in Michigan is generally a reduction, and sometimes the total loss, of suitable trout habitat and thus trout! If someone asked you to support cutting practices that would increase the abundance of trout, grouse, woodcock, deer, otter, mink, eagles, wetland plant and animal species, and so on, your answer would probably be an emphatic yes! Unfortunately, no single RMZ cutting strategy will simultaneously maximize production of these species. Therefore, value judgments and choices are required that lead to compromise. It is through this process that MDNR creates diversity in treatments, and ultimately balance and diversity among competing opportunities to use and enjoy the State's abundant natural resources.

Beaver dams cause water warming, increase evapotranspiration, store sediment and woody debris, and can block free movement of resident and migratory fish. Beaver activities increase sediment delivery to streams and bury large woody debris and spawning gravel in impounded areas. These stored sediments may be released in mass during dam washouts from snowmelt or rainstorms, which can cause sedimentation problems in the stream. In Michigan, warmer habitats created by beaver favor non-game fish species that compete with trout. Loss of canopy trees in riparian corridors due to beaver activity reduces shading and causes a long-term interruption of the supply of woody debris to the stream system. Beaver dams may also reduce diversity of benthic invertebrate communities and can cause changes in water chemistry that are detrimental to trout.

Even so, no one will argue that the occasional beaver dam on a stream is a major problem for trout. Beavers are native to Michigan and are an important component of Michigan's ecosystem. Beaver ponds can be a rare and unique resource by providing habitats required by some important plant and wildlife communities. Many trout anglers also know that beaver ponds can provide great fishing for a short while after they are built in certain locations in our state. However, when large aspen clearcuts are done in the riparian zone, they often make conditions *too* favorable for beavers. Such practices result in multiple beaver dams in

relatively short stretches of stream. That *is* a major problem. All of the problems outlined above are greatly magnified and the trout stream in question becomes a severely degraded resource.

During compartment reviews, fisheries biologists often advocate management practices in RMZs that discourage aspen regeneration, particularly on small streams that they view as critical habitat for trout. An example of a critical trout habitat is a small, cold tributary stream used by trout for reproduction or for refuge from warmer summer temperatures of larger streams. The cold-water discharge from such a stream can also be critical for maintaining suitable temperatures for trout in the larger stream. By contrast, small streams where summer temperatures are already too warm for trout, perhaps because they originate from or flow through lakes or because they receive little groundwater inflow, may be good sites to promote aspen regeneration. Similarly, regeneration of aspen near larger trout streams greater than 50 feet wide is less likely to have a negative impact on water temperatures because beaver rarely dam larger streams. Yet, beaver activity can still impact woody debris inputs into these larger streams, many of which are lacking in LWD.

Thank Goodness for Four Million Acres!

As you can see, managing riparian zones is not easy. In fact, it is a very complex process involving many different interests, and what is good for one interest may be bad for another. The most important fact to remember is that there is no "one size fits all" policy. That's why our State Foresters, Fisheries, and Wildlife biologists manage each forest compartment, and hence each riparian zone, on a case-by-case basis. Each compartment is scrutinized by all to determine what should be the number one priority, and then the appropriate management actions are prescribed. Compromise and cooperation between MDNR and the public, as well as between different Divisions within MDNR, are very important for creating and maintaining an appropriate and diverse balance of natural resources for all to enjoy. The upside to it all is that we are blessed in Michigan to have four million acres of State Forest land to debate about and compromise on. Thank goodness for that!

The result of proper riparian zone management: fat, healthy brown trout. Photo courtesy of Paul Murphy, National Park Service.

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